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## EDITORIAL OPINION

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# Spontaneous Succession versus Technical Reclamation in the Restoration of Disturbed Sites

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## Abstract

We address the question: under which circumstances can we rely upon spontaneous succession and when are technical measures more effective in restoration programs? To answer this question, the position of a disturbed site along the productivity–stress gradient was considered. The probability of attaining a target stage by spontaneous succession decreases toward both ends of the productivity–stress gradient, whereas the acceptance of technical measures

generally increases. In correspondence with that, the monetary cost of restoration increases toward the ends of the gradient. Therefore, spontaneous succession is advocated especially if environmental site conditions are not very extreme.

**Key words:** diversity, ecological restoration, environmental stress, manipulation of succession, site productivity, target stage.

## Introduction

The ideas presented here concern predominantly newly created habitats where succession or technical reclamation usually start on bare substrata. Vegetation (vascular plants) is predominantly considered here as the main part of at least terrestrial ecosystems, being easily observed and mostly representing a main target of restoration programs (Young et al. 2005). Basically, there are three approaches to restore a disturbed site: (1) to rely completely upon spontaneous succession, (2) to exclusively adopt technical measures, and (3) to combine both previous approaches by manipulating spontaneous succession toward a target. We can see a continuum between purely technical measures and only spontaneous succession, manifested in various intensity and extent of manipulation of spontaneous succession. However, it should always be taken into account that spontaneous succession interferes to varying extents with any technical approach. A core question addressed in this paper is under which circumstances can we rely upon spontaneous succession and when are technical measures preferential? To answer this question, we especially need to consider goals of restoration, the position of disturbed sites on environmental gradients, and sources of diaspores of species in the surroundings of

a disturbed site. The goals are basically of two types: (1) to increase the natural value of a disturbed site and (2) to improve ecosystem functions and services, such as productivity or protection against erosion (Hobbs & Norton 1996). Here, the first goal is emphasized.

## Where is Each Approach Most Appropriate?

It is useful to summarize environmental gradients into a productivity–stress gradient (Grime 1979) to which various structural and functional characters of ecosystems are related and which largely determine the preference for either spontaneous succession or technical restoration. The issue is summarized in a conceptual scheme in Figure 1. The ideas illustrated in this diagram are related to those recently discussed in relation to the likelihood of the emergence of novel ecosystems (Hobbs et al. 2006) and in relation to the development of context-specific models of succession on abandoned farmland (Cramer et al. 2008).

It is generally accepted that diversity is highest at a moderate level of stress or productivity, as the number of species able to grow is limited physiologically or by competition, respectively, toward the ends of the stress–productivity gradient (Grime 1979). Moreover, at both ends, potential species pools are expected to be less numerous than in the middle of the gradient to which more species are evolutionarily adapted (Safford et al. 2001). Increasing the total number of species should not be a goal *per se* in restoration programs. It is reasonable to distinguish roughly between desirable and undesirable species. Simple categories of species may be useful to consider: for example, species typical for grassland and woodland are generally desirable, whereas ruderal and alien

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